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Special Issue on Agentic Foundation Models for Smart Manufacturing

Foundation models aim to provide systems with extensive generalization capabilities. However, automated manufacturing presents unique challenges that differ significantly from the internet-scale data used to train general-purpose LLMs and VLMs. Manufacturing environments are characterized by sparse, small-sample, and highly heterogeneous data (ranging from 1D sensor signals and 2D images to 3D CAD models). Therefore, mere application of off-the-shelf models is often insufficient. This special issue focuses on the development and rigorous adaptation of foundation models specifically for manufacturing constraints, addressing how to construct robust models despite limited failure data and complex physical dynamics.

This special collection is predicated on a dual objective: (1) understanding the current capabilities and limitations of foundation models in automated manufacturing contexts, and (2) advancing the design and adaptation of such models to meet these challenges. We encourage submissions that provide critical insights into the limitations of current foundation models within real-world automated manufacturing contexts, as well as elucidate how novel architectures, training paradigms, or system designs may address these deficiencies.

Within the above context, the scope of this special issue includes, but is not limited to, the following topics:

- Agentic AI and Embodied Reasoning: Developing autonomous manufacturing agents capable of long-horizon planning, tool use, and active error recovery in unstructured environments
- From Semantic to Metric: Bridging the gap between high-level semantic reasoning (LLM) and precise metric control (Servo) in automation systems
- World Models for Manufacturing: Learning thermodynamics, kinematics, and process dynamics from video/sensor data to enable predictive control and model-based reinforcement learning
- Cross-embodiment learning: Transferring knowledge across different robot morphologies and manufacturing processes to maximize data utility
- Industrial-Grade Trustworthiness: New approaches to explainability and formal verification to ensure reliability in safety-critical manufacturing processes
- Physics-informed foundation models: Incorporating physical laws and domain knowledge into model architectures to compensate for data scarcity
- Methodologies for developing foundation models using small, sparse, or unbalanced manufacturing datasets

Important Dates

- Paper submission deadline: September 1, 2026
- Completion of the first round review: December 1, 2026
- Completion of the second round review: February 1, 2027
- Final submission due: March 1, 2027
- Tentative publication date: July 1, 2027

Guest Editors

Dr. Binglu Wang
Northwestern Polytechnical University, CN
wbl@nwpu.edu.cn

Dr. Xiaoyu Guo
City University of Hong Kong, HK
xiaoyguo@cityu.edu.hk

Dr. Hongsheng He
The University of Alabama, USA
hhe11@ua.edu

Dr. Zuowei Zhang
Northwestern Polytechnical University, CN
zhangzuowei@nwpu.edu.cn

Dr. Chenguang Yang
University of Liverpool, UK
Chenguang.Yang@liverpool.ac.uk

Dr. Huaping Wang
Beijing Institute of Technology,CN
wanghuaping@bit.edu.cn

Dr. Jun Yang
Loughborough University, UK
j.yang3@lboro.ac.uk

Dr. Juan José Rodriquez-Andina
University of Vigo,Spain
jjrdguez@uvigo.es

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